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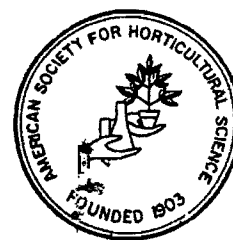
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# A REVIEW OF PEANUT CULTIVAR EVALUATION IN JAMAICA

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## ABSTRACT

Work on peanut cultivar evaluation in Jamaica is reviewed. Over 100 introductions have been made in recent years and several have shown improved yield and kernel size compared to the local Valencia cultivar. Differences in season length (90 to 150 days) make comparison of cultivars based on kernel yield per unit area alone unsatisfactory for assessing the order of merit. The time factor must be taken into account to determine the economic rate of return on investment. Kernel yield in  $\text{kg ha}^{-1}$  per 5-day period of growth is suggested as the most suitable criterion for comparative performance.

Socio-economic factors suggest that cultivars of short season length and erect bunch habit as represented by Spanish/Valencia market types are suited to the rainfed conditions and low management input production system of small farmers.

Large seeded cultivars with spreading habit and requiring a long season length as represented by Virginia/Runner market types are suited to large farms equipped with machinery and irrigation facilities.

## RESUMEN

Esta es una revisión del trabajo de evaluación de cultivares de maní llevados a cabo en Jamaica.

En años recientes más de 100 variedades fueron introducidas y muchas de ellas mostraron mejoras en cuanto se refiere a la producción y al tamaño del grano, comparadas con la variedad criolla, el cultivar Valencia. Variaciones estacionales (de 90 a 150 días) hacen que la comparación de cultivares, basada solamente en la producción del grano/unidad de superficie, no sea satisfactoria para poder evaluar el orden de mérito. El factor tiempo se debe considerar para poder determinar la tasa económica de rendimiento de inversión. El criterio más adecuado para la comparación del desempeñamiento de las diferentes variedades es, el de la producción del grano por  $\text{kg ha}^{-1}$  per 5 días de crecimiento.

Factores socio-económicos sugieren que las variedades precoces y con un hábito de crecimiento arbustivo, como ser el de la variedad Spanish/Valencia, son adecuadas para condiciones pluviales y para el sistema de manejo de baja producción de los pequeños agricultores.

Las variedades de grano grande y de guía larga y de tipo de crecimiento de día largo representadas por la variedad Virginia/Runner, son adecuadas para plantaciones en fincas grandes equipadas con maquinarias y equipo de irrigación.

Keywords: Peanut, Cultivar evaluation, Jamaica.

## Early research

Peanut varietal assessment in Jamaica attracted attention soon after the Second World War. Investigative Bulletins 1949/50 and 1950/51 of the Ministry of Agriculture report on a series of trials conducted under the various ecological conditions prevailing at four agricultural stations.

The seven cultivars under test were PL-118475, PL-148353, Virginia Bunch, Dixie Runner, Swaziland and Local Valencia. The low yields ( $685-970\text{kg}$  dried nuts  $\text{ha}^{-1}$ ) obtained may be attributed mainly to the wide spacing used -  $30\text{cm} \times 60\text{cm}$ .

The literature does not indicate any further research being done in Jamaica on variety testing until after an unfortunate attempt at large scale production at Hounslow, St. Elizabeth in the 1960s. The cultivar imported from the USA proved highly susceptible to the local disease complex and the disaster that resulted served as a deterrent to the development of the peanut industry for several years.

The incident, however, focused attention on the need for research and the Botany Department of the University of the West Indies (UWI), undertook a study of the reaction of local and imported peanut cultivars to infection by rust (*Puccinia arachidis*) and leaf spot (*Cercospora personatum*)

Of the 17 early maturing types tested, four were considered resistant to rust, three of these (PL-259747, PI-341879, (Tarapoto) and PI-350780) were also considered resistant to leaf spot.

The Local Spanish and Local Valencia, both early maturing, were classed as moderately resistant to rust but highly susceptible to leaf spot.

Among the 17 medium maturing varieties five were deemed resistant to rust and of these Florida 439-16 and NC-13 were also resistant to leaf spot.

Eight late maturing types were tested and of these only Virginia 56R was rated as being resistant to both rust and leaf spot. Unfortunately, there was no immediate follow-up of this work. To date, the UWI recommendation that large plots of Local Valencia should be grown and the most disease-resistant plants selected for bulking of their progeny has not been pursued. The possibility of upgrading the Local Valencia's performance by selection remains an area rich for research since it is known to contain a number of lines.

## A preliminary evaluation of ICRISAT selections

In 1981, the International Groundnut Foliar Disease Nursery (IGFDN) in collaboration with the International Crop Research Institute for the Semi-arid Tropics (ICRISAT) provided CARDI (Jamaica Unit) with 43 selections for evaluation of disease resistance in different environments.

Comparison was made against the Local Valencia in a replicated trial on Maverley Loam at Mona. This investigation is presented in detail in the 1982 Annual Report of CARDI - Jamaica.

The cultivars were maintained using a high standard of husbandry except that fungicides were not used. For each plot, records were taken of the dates of first appearance of three diseases – rust, early leaf spot and late leaf spot. Guided by the ICRISAT 9-point field scale the severity of each of the three diseases was recorded, 70 and 94 days after planting.

It is reasonable to assume that the effect of disease on yield will vary according to:—

- The stage in the life cycle of the cultivar when infection occurred.
- The severity of the attack.

All cultivars in the trial were harvested within 122 days after planting and it was assumed that where slight or moderate disease severity occurred late in the life cycle of a cultivar (that is after 94 days) its yield potential would not have been altered

appreciably. If however, the same level of severity occurred early, namely within 70 days (mid-crop) and this severity did not intensify with time, the yield potential was considered to be affected moderately. Using these assumptions Table 1 was drawn up.

Of the 19 selections where the disease complex was considered to either have had no effect or only a slight one, 14 were erect bunch, short season (15 – 110 days) types; the others were spreading bunch, medium season (111 – 125 days) types. The Local Valencia was also included in this group.

Six of the short season types, but none of the medium season type yielded better than the Local Valencia which produced the equivalent of 3770kg ha<sup>-1</sup>. Of this group ICG-7886 gave the highest yield of 5020kg ha<sup>-1</sup>; the others ICG-2716, 7893, 7896, 7897 and 7898 produced between 3865 and 4490kg ha<sup>-1</sup>.

Table 1 The assumed relationship between levels of disease severity and the yield potential of peanut cultivars

Disease severity level at 70 days	Disease severity level at 94 days	Assumed disease effect on yield potential
Clean (Score 1 or 2)	Clean	None
Clean	Moderate (Score 3 or 4)	Slight
Clean	Severe (Score 5 or 6)	Moderate
Clean	Very severe (Score 7 or over)	Severe
Moderate (Score 3 or 4)	Moderate	Moderate
Moderate	Severe	Severe
Severe (Score 7 and over)	Severe	Very Severe

It is interesting to note that the highest yield of all was from ICG-1697 which gave 6160kg ha<sup>-1</sup>, although this selection was severely affected by disease.

In fact, nine of the 15 selections with higher yields than the Local Valencia appeared to be more severely affected by disease. These findings suggest that the better performing introductions were capable of expressing their higher yield potential under conditions of high management inputs even without the use of fungicides.

#### The effect of management on yield of six high yielding ICRISAT selections

In the following season, (1982) six of the highest yielding ICRISAT selections were included in a series of six trials – two trials on each of the three major soil types used for peanut production in the parish of St. Elizabeth. The objective was to compare their performance with the indigenous Valencia under the low input management conditions of small farmers.

Mean yields at the six sites are presented in Table 2 along with the mean yield of the same selections grown in the same season but under high input management conditions (including the use of fungicides) at agricultural research stations.

The yield of the Local Valencia in these trials was consistent with its long term average under small farm conditions. The introductions with high potential yield under good management (Table 2) did not perform as well as the Valencia under the low input conditions on small farms.

Table 2 The effect of levels of management on yield (kg dried nuts per ha) of selected cultivars of peanut)

Cultivar	Management	
	Low	High
Local Valencia-Standard	1401	3320
ICG-1703	1334	3819
ICG-7882	1252	4587
ICG7898	1234	3468
ICG-1710	1149	3803
ICG-1712	1093	3921
ICG-7895	1025	3638

## Recent cultivar evaluation

Since 1982 field and laboratory investigations have involved 111 cultivars:

- 43 ICRISAT selections
- 28 ICRISAT breeding lines and
- 40 U.S. selections

Field investigations have taken the form of observation plots (unreplicated) and replicated trials.

The better performing selections were included in six replicated trials. Randomised complete block designs with four replicates were used in all these trials. Plots consisted of four rows 3.6m long. Seeds were spaced 15cm apart with rows 60cm apart.

In establishment and maintenance a high standard of husbandry as set out in CARDI's Teck-pack (1982) for peanut production was maintained under the irrigated conditions at the two stations involved.

Records were taken of:

- Stand count at 2 weeks and at harvest
- Dates of first appearance of leaf-spot and rust and levels of infection according to a 9-point scale, at mid-crop, at 75 per cent duration and finally at harvest.
- Season length as determined by lifting trials — maturity at 70 — 80 per cent of large nuts.
- Dried nut yield taken after 4 days of sun drying on a concrete barbecue.
- Shelling percentage and grading of kernels carried out on 0.45kg composite samples.

Variable seed viability caused much interplot variation within treatments. To reduce the effect of this variable, yields were adjusted to a constant population of 107,640 plants ha<sup>-1</sup>. This adjustment gives an unfair advantage to cultivars which failed to produce many plants for harvest.

### *Ranking by yield*

High yield variability in the trials prevented establishing with confidence the order of merit of the cultivars under test. However, under similar conditions of husbandry, several observations should allow establishing a consistent order for the cultivars relative to the Local Valencia.

In Table 3 mean yields of nuts from the indicated number of trials are rounded to the nearest 100kg and expressed as a percentage of the mean yield of the standard Local Valencia set at 100. The cultivars are grouped according to market types. The selection ICG-7898 had the highest ranking percentage yield. The Local Valencia was the highest ranked Valencia market type.

### *Productivity*

Kernels are the most valuable part of the peanut. Hence, comparison of cultivars based on their kernel yield rather than their dried nut yield gives a better measure of their merit. The productivity of a cultivar can be expressed in terms of its kernel weight (kg) per ha per 5-day period of growth. (Table 3). The choice of a 5-day period recognises the difficulty in pinpointing maturity periods for optimum recovery of nuts at harvest.

On this criterion, Florunner was the highest ranking Runner market type and it also outranked the top performers of the Virginia market type. However, the selections ICG-7898 and ICG-7886 both of uncertain market type were superior to the Florunner (Table 3).

### *Ranking of kernel grades by market type*

The size of the kernels and their uniformity are important qualities influencing the price paid for peanuts. The size fractions of seed samples of each cultivar were determined using a series of sieves with 14, 16, 18 and 21 mesh. The weight percentage of each fraction was established with their respective seed count per 100g. Only the two large fractions and their seed counts are reported in Table 4 by market type.

Considerable differences in seed count occur between cultivars both within and between market types but in general the large seed size of the Virginia market types is outstanding being almost twice that of the Spanish/Valencia market types. The weight percentages of the largest fraction retained on the 21 mesh sieve for both the Virginia and Runner market types are in general larger than those of the Spanish/Valencia types indicating greater seed uniformity. Excellent uniformity — 98 per cent by weight — occurred in seed of cultivars ICG-6330, NC-7 and PI-315608. The indigenous cultivar, Local Valencia, possesses seed of wide size variability. Uniformity and size are both important.

Table 3 Ranking of peanut cultivars with Local (Jamaica) Valencia as standard

	No. of Expts.	* Approx. mean yield (kg/ha) nuts	** Percentage yield	Season length (no. of 5-day periods)	Approx. mean kernel yield (kg/ha)	Relative productivity (kernel yield) 5-day period of growth
Virginia Market Types						
VA Bunch G2	2	4700	182	26	3440	132
NC-2	2	4600	159	25	3300	132
NC-7	6	4400	152	28	3150	112
Florigiant	3	3900	139	26	2740	105
Va 81B	2	3600	124	26	2540	88
Va 61R	2	3200	110	28	2440	87
NC-6	2	2900	100	26	2270	87
Va Runner						
G26	2	2600	90	26	1860	72
Early Bunch	2	1500	52	26	1130	43
Runner Market Types						
Early Runner	2	4600	159	26	3540	136
Florunner	3	3700	128	26	3700	142
Dixie	2	2600	90	25	1780	71
Va Bunch 67	2	2500	86	25	1720	89
Spanish Market Types						
Argentine	2	4000	138	26	3070	118
Comet	5	3900	139	23	2870	125
Pronto	2	2600	124	25	2820	105
lifspan	2	2900	100	23	2180	95
Starr	3	2800	86	23	1960	85
Valencia Market Types						
Tennessee Red	3	2700	93			
Local Jamaica (Standard)	5	2900	100	20	2180	109
NM Val A	3	1600	55	23	1190	52
Unspecified Market Types						
ICRISAT Selections						
ICG-7898	4	5500	190	25	4010	160
ICG-7886	6	5300	183	25	3790	152
ICG-1697	6	4500	155	25	3270	131
ICG-6330	4	4300	148	25	3100	124
ICG-7900	2	3500	121	25	2500	100
Other Cultivars						
Mat. 119	2	3400	117	23	2450	107
Altika	4	3100	107	26	2280	88
Dixie						
Anak	2	2700	93	25	1880	75
Norden						
Fla.	2	2400	83	22	1690	77
C-501	2	2400	83	25	1560	60
PI-315608	2	2100	72	25	1490	60

\* Rounded to 100kg

\*\* Local Valencia as standard, Yield of 2900kg per ha=100

Table 4. Ranking of peanut kernel grades by market types

Variety	Retained on 21 mesh sieve		Retained 18-21 mesh sieve	
	% by wt.	Seed count/100g	% by wt.	Seed count/100g
<b>ICRISAT Selections</b>				
ICG-6330	98	180	2	266
ICG-7898	92	180	7	250
ICG-88	88	187	11	257
ICG-7900	84	137	13	247
ICG-1697	76	193	22	257
<b>Virginia Market Types</b>				
NC-7	98	103	2	210
Va Runner G26	95	123	5	183
NC-2	92	110	4	200
Va 61R	91	123	7	220
Va Bunch G2	90	130	9	197
Va 81B	91	123	9	900
NC-6	90	143	9	263
Early Bunch	90	180	10	253
Florigiant	63	143	27	207
<b>Runner Market Types</b>				
Florunner	92	157	7	263
Early Runner	90	163	8	240
Dixie Runner	90	130	7	203
Va Bunch 67	44	183	36	243
<b>Spanish Market Types</b>				
Comet	80	193	16	293
Argentine	74	223	25	273
Starr	70	226	30	247
Tifspan	68	237	30	290
Pronto	68	200	30	253
<b>Valencia Market Types</b>				
NM Val. 4	86	203	13	273
Local Valencia	73	210	24	267
Tennessee Red	60	233	38	257
<b>Other of uncertain Market Types</b>				
PI-315608	98	76	1	320
Norden Fla.	96	113	3	390
Altika	92	120	6	237
Dixie Anak	91	153	7	207
Mat. 119	90	153	7	277
C-501	70	190	22	287

*Disease susceptibility of cultivars*

An assessment of the effectiveness of the CARDI disease control recommendations was carried out on a Mona variety trial, planted 15 November 1984. Nine cultivars were involved: ICG-1697, ICG-6330, ICG-7886, ICG-7898, Va Bunch G2, Florunner, Comet, NC-7, Local Valencia. The spray programme involved low volume application at recommended rates of the cocktail mixtures set out below:

	Days after planting	Insecticide	Fungicide	Sticker
1 <sup>st</sup> Application	15	Basudin 40 WP	Daconil 2787 WP 75	Citomel
2 <sup>nd</sup> Application	85	Sevin(1kg/ha)	Dithane M45 (2 kg/ha)	Gaispray

Daily monitoring (excluding weekends) of the disease complex was rated on the 9-point field scale.

Leaf spot appeared simultaneously in most of the plots occupied by each of seven of the nine cultivars being compared on the 83rd day after planting. At this stage none of the plots of either ICG-7886 or Florunner showed symptoms of this disease which was the sole disease that had appeared. Infection of the latter cultivars occurred on the 88th day after planting. Rust was identified in Comet plots on the 90th day after planting but none of the other cultivars suffered from the disease.

At 115 days after planting ICG-6330 and ICG-7886 were only slightly affected (point 2 on the 9-point scale). All the others including the Local Valencia rated 3 except Comet which was severely affected (5).

At harvest disease severity was moderate (3) for ICG-6330, ICG-7886 and the Local Valencia. Severe symptoms were recorded for all the others with Comet and NC-7 being very severely affected.

The season length (a) of a cultivar may be divided into two periods as follows:

- A disease-free period (b) extending from the date of planting to the date of first appearance of diseases.
- A disease-infected period (a-b) extending from the date of first appearance to the date of harvest

The rate of build up of disease is represented by dividing the level of infestation at harvest (c) by the length of the period of infection (a-b). The value obtained for Local Valencia was rated as 100 and the value of other cultivars determined by comparison with the standard (see Table 5).

Using these criteria Comet was the most disease susceptible cultivar and ICG-7886 the least.

The disease-free period of 83 days after planting was exceptionally long in comparison to the usual 60 day period. This may be attributed to weed-free conditions in combination with the early preventative pesticide application.

With the exceptions of Comet and ICG-7886, the level of infection increased with the season lengths of the cultivars (Table 5). The high level of disease in the case of the short season Comet is in keeping with its known high susceptibility to rust. In the case of the long season cultivar ICG-7886, the low level of disease severity at harvest shows that the cultivar was even less susceptible than Florunner which exhibited a similar delay of infection.

Table 5. Relative rate and accumulated build up of diseases in peanut planted in November 1984 at Mona, Jamaica.

Cultivar	Season length (days)	Disease-free period (days)	Disease-infected period (days)	Total score of disease severity* at harvest	Index of rate of disease build up	Relative rate of disease build up (Valencia=100)
	(a)	(b)	(a-b)	(c)	[(c)/(a-b)]	
<b>Local</b>						
Valencia	121	83	38	3	0.07	100
ICG-6630	116	83	33	3	0.091	115
Comet	121	83	38	7	0.184	233
ICG-7898	134	83	51	5	0.098	124
ICG-7886	134	88	46	3	0.065	82
Florunner	134	88	46	5	0.109	138
VB-G2	134	83	51	5	0.098	124
ICG-1697	149	83	66	5	0.076	98
NC-7	149	83	66	7	0.106	134

\* ICRISAT Scale (1-9)

#### *The significance of season length on cultivar selection*

The time interval from planting to maturity is an important characteristic in determining a cultivar's suitability to an ecological zone.

The season lengths for eight cultivars planted at two contrasting sites at different times are shown in Table 6. With one exception, ICG-6920, season lengths on the Caymanas Sandy Loam were earlier than those for the same cultivars on the Maverley Loam. Yields also indicate a trend for each cultivar to perform better on the Caymans Sandy Loam compared to the Marveley Loam. Insufficient meteorological data are available to explain this behaviour.

Table 6. Season length (days) of selected cultivars grown in trials at Mona and Lawrencefield, Jamaica.

	Planted Mona November, 1984	Planted at Lawrencefield, January, 1985	Difference in season length (days)
	Marverly Loam 270m above sea level	Caymanas Sandy Loam, 30 m above sea level	
NC-7	149	119	30
ICG-1697	149	123	26
Florunner	134	119	15
ICG-7886	134	123	11
ICG-7898	134	126	8
<b>Local</b>			
Valencia	121	108	13
Comet	121	119	2
ICG-6330	116	123	(1)

However, factors such as time of planting and temperature, as a result of difference in elevation, are involved. The warmer environment of the low lying Caymanas Sandy Loam appeared to have favoured earliness. Photoperiodism of peanuts has previously been observed in Jamaica. Spring planted Valencia (April/May) experiences a period of increasing temperature and day length with advent of summer. This combination of conditions appears to hasten maturity which usually occurs within 105 days of planting.

Fall planted Valencia (September/October) on the other hand, experiences a period of declining temperature and shortening of day-length with the approach of the winter months. These factors combine along with adequate rainfall in October/November to cause postponement of maturity to 115 days. Higher yields also characterise this period. Increased season length means that land is tied up for a longer period, and this is usually accompanied by increased cultivation costs as a result of the need for added plant protection measures. In general the erect bunch types have a shorter duration than the spreading types.

Thus the indigenous Valencia cultivar has proven popular as a reliable cash crop for small farms in Jamaica for the following reasons:

- Short season length (110 days) and drought resistance allow the cultivar to fit conveniently with reduced risk into the rotational production systems dependent mainly on natural rainfall.
- Considerable tolerance to late leaf-spot and rust assures some returns with no or minimal investment in expensive imported fungicides.
- Compact fruiting habit combines with the strongly aggregated condition of the major soil types — Red Bauxite (St. Ann Clay Loam), Brown Bauxite, (Chudleigh Clay Loam) and Newel Clay Loam — to facilitate hand reaping. Indeed with the widely scattered patches of peanut cultivation, mechanized harvesting would be uneconomical.

#### **Conclusions and recommendations**

Low yields of 1000kg dried nuts ha<sup>-1</sup> characterise small farm production systems in Jamaica. Confirmed investigations indicate that considerable improvement in productivity will be obtained from the indigenous cultivar known as Valencia with the adoption of the technological practices recommended by CARDI. The yield potential of the indigenous cultivar appears to be limited to about 3000kg ha<sup>-1</sup>



but at this level it is still the best performing Valencia market type examined to date. Upgrading this performance by selection of progeny of the plants with the highest pod count and exhibiting the greatest resistance/tolerance to the challenge of the local disease complex is an area rich for research.

Preliminary examination on research stations of over 100 selections received from ICRISAT and CRSP have already revealed several genotypes of superior yield potential and seed quality than the Local Valencia. A long term evaluation programme is essential to establish the order or merit of the more promising selections in major ecological areas in which peanut production is already or potentially important.

The order of merit or the appropriateness of a selection depends on a number of factors which will optimise utilisation of local resources, both human and capital. The higher yield potential of a cultivar is the prime consideration as it reduces the unit cost of production. However, high yields of improved cultivars can only be realised through high management inputs which include an integrated plant production programme and it is in this regard that selections with resistance/tolerance to the challenge of the local disease complex gain importance in reducing the cost of fungicidal control. Disease resistance/tolerance and cultural measures for pest control are particularly valuable and appropriate to Jamaica's production system due to the high cost of foreign inputs. Nevertheless, selection for disease resistance is merely complementary to the prime objective of increased yield, as high yielding cultivars can well afford to pay for added plant protection measures and still give increased returns to the farmer. Much research therefore needs to be done on the frequency of application of the improved pesticides now available to maximise returns to the farmer.

Season length of a cultivar is another important consideration that determines its suitability for Jamaica with its seasonal rainfall distribution. Short rainy periods favour short season length cultivars as being more in keeping with natural resources. Satisfactory production from long season cultivars will only be feasible in areas with supplemental irrigation.

For assessing the order of merit of cultivars, the criterion of kernel yield in kg per ha per 5-day period of growth is suggested as being most suitable for ranking performance.

Contrasting socio-economic conditions, existing between the two major ecological areas identified as being particularly suitable for peanut production, suggest separate strategies for peanut expansion. In the low lying limestone zone of St. Elizabeth in which Valencia production is traditionally important, development would be better based on expansion of Spanish/Valencia market types. The preponderance of small farms in this zone makes employment benefits, at the size of individual farm enterprise, a significant factor of resource utilization. Higher labour efficiency is facilitated in the cultivation of erect bunch types and in their subsequent harvest. Furthermore, sloping topography causing difficulties for mechanisation with high efficiency, combine with the wide adaptability of small seeded cultivars to give support to the zoning of market types.

On the other hand, the predominant plantation system of land tenure associated with the other major ecological zones on the Southern Plains with alluvial soils and irrigation facilities, will more readily accommodate the large seeded Virginia/Runner market type. Economies of scale will be possible, and capital intensive technology involving the use of digger-shakers and combine harvesting will be required for profitability as the cost of hired labour in Jamaica is high in terms of its productivity. Under these conditions, the higher productivity per plant of spreading cultivars might be advantageous. Indeed, it is on the potential of this ecological zone for peanut production that success of significant industrial development depends.

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